**5.2 Designing Experiments**

**Parts of an Experiment:**

* **Experimental Units**:
* **Treatment**:
* **Factors**:
* **Level**:
  + Combination of levels and factors form the treatment.
  + Ex…
    - Factors: Dosage, temperature
    - Example: 200mg given orally, 400mg administered intravenously

**Principles of Experimental Design**

**Goal:** Find *statistical significance*…the observed effect is so large that it is unlikely \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

**1. Control**

* + Minimize the effects of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ by comparing several treatments in the \_\_\_\_\_\_ environment. (utilize placebos and control groups)
  + Placebo Effect:

2. **Replication**

* + Use many experimental units to reduce \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in the results

**3. Randomization**

* + Use \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to assign experimental units to treatments.

**Types of Experimental Designs:**

1. **Completely Randomized Design**
   * aka a basic comparative experiment
   * \_\_\_\_ experimental units are allocated \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ among all the treatments
   * Example:
     1. I want to test a new drug that supposedly lowers cholesterol.
     2. I decide to test two different treatments
        + 100mg of the drug
        + 200mg of the drug
2. **Block Design**
   * An experiment is conducted separately for \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (\_\_\_\_\_\_\_) of experimental units.
   * Use blocks only if you expect certain groups of units/subjects to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_ the response to the treatments.
   * It is similar to stratified random sampling.
   * Example:
     1. I want to test a new drug that supposedly lowers cholesterol.
     2. I decide to test two different treatments
        + 100mg of the drug
        + 200mg of the drug
   * I have reason to believe that subjects that are 65+ will react differently to the drug than subjects who are under 65.
3. **Matched Pairs Design (type of block design)**
   * Compares two treatments by comparing the response of two matched experimental units.
   * Units are matched one of two ways….
     1. Two different units/subjects matched based on similar characteristics (e.g. identical twins)
     2. One subject/unit receives both treatments (i.e. A person is paired with him/herself. Each subject serves as his/her own control.)

* **Randomization** is still used to determine who gets which treatment, or which treatment is given first.
* Ex: Does this new basketball I made increase the number of free-throws made?

(a) Two different units/subjects matched based on similar characteristics

**Match** subjects based on height

**Randomly assign** subjects in each pair to ball type A or ball type B by flipping a coin

**Test** the subjects

**Compare** results from ball type A and Ball type B

(b) One subject/unit receives both treatments (i.e. A person is paired with him/herself. Each subject serves as his/her own control.)

Each subject tests **both** basketball types

**Randomly assign** subjects in start with either type A or type B.

**Test** the subjects with both types of basketballs (in the order decided on by chance)

**Compare** results from ball type A and Ball type B

**Other Considerations with Experiments**

* It is sometimes better if the experiment is conducted in a ***double-blind*** manner.
  + Neither the\_\_\_\_\_\_\_\_\_\_\_ nor the people \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ know which treatment the subjects received.
* Sometimes a *lack of realism* is a problem for experiments.
  + A laboratory setting is not always the same as real life, which makes it difficult to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
* Don’t forget to describe your \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in detail when writing an open-ended response!!!!
* **Random sample**
  + Allows you to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
* **Random allocation** to treatment groups
  + Allows you to state that the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ between the responses in the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ was due to the effects of the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, not the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of the subjects.